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Test Specification for the Alternate Repair Verification Process of the Finnish Air Force Digital Memory Unit Writer

MICHAEL E. TRENCHARD
LANCELOT RIEDLINGER

*Mapping, Charting, and Geodesy Branch
Marine Geosciences Division*

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14. ABSTRACT The Digital Memory Unit Writer (DMU) is a ruggedized optical drive assembly built by Honeywell. The DMU writer is used specifically to write specially formatted map data to militarized Aircraft Optical Disks (AOD) for use in the AN/ASQ-196 Digital Map System (consisting of both a Digital Map Computer and a DMU reader) of both U.S. and Ally AV-8B Harrier and F/A-18 Hornet aircraft. The AN/ASQ-196 and its support equipment (including the DMU writers) have been in use by the Fleet for well over 13 years. Obsolescence problems exist with the AN/ASQ-196 and its support equipment. In particular, DMU writers have proven to be much less rugged, reliable, and more sensitive to power fluctuations than DMU readers, particularly in recent years when obsolescence issues have become more prevalent. In addition, only a handful of DMU writers exist (less than 15 overall) compared to several hundred DMU readers. While DMU writers suffer from obsolescence and reliability.					
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TEST SPECIFICATION
FOR
THE ALTERNATE REPAIR VERIFICATION PROCESS OF THE FINNISH AIR
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1.0 GENERAL

- 1.1 This test specification outlines and describes the alternate test procedures to be used to validate all repairs of the Finnish Air Force (FIAF) Digital Memory Unit (DMU) Writer. An alternate FIAF DMU Writer Repair Verification Process is now required to compensate for the failure of the Honeywell DMU Writer test bench previously used to Validate and Verify all DMU Writer repairs made by Honeywell. Unfortunately, the Honeywell DMU Writer test bench cannot be repaired due to the unavailability of obsolete repair components/piece parts. The cognizant organization tasked to perform the alternate test procedure to validate and verify FIAF DMU Writer repairs is:

Naval Research Laboratory (NRL) Detachment, Stennis Space Center, MS
→ DMU Writer Repair/Rework Validation/Verification (Val/Ver)

Address: DIRECTOR
NAVAL RESEARCH LABORATORY
ATTN: M. TRENCHARD, CODE: 7440.1
STENNIS SPACE CENTER, MS 39529-5004

Ph: (228) 688-4633
Fax: (228) 688-4853

1.2 Background

The FIAF Digital Memory Unit (DMU) Writer is a ruggedized optical drive assembly developed and built by Honeywell, Inc. The DMU Writer is used specifically to write specially formatted digital moving map data to militarized Aircraft Optical Disks (AODs) for use in the AN/ASQ-196 Digital Map System (consisting of both a Digital Map Computer (DMC) and a DMU reader) in AV-8B Harrier and F/A-18 Hornet model aircraft. The AN/ASQ-196 and its associated support equipment (including the DMU Writer) have been in Fleet use for over 13 years. Severe parts obsolescence problems exist with both the AN/ASQ-196 system and its associated support equipment. In actual service use, DMU Writers frequently exhibited poor reliability and proved to be exceptionally sensitive to input electrical power fluctuations. This situation continues to deteriorate as DMU parts obsolescence issues become more widespread and severe with the progression of time. Additionally, less than fifteen (15) DMU Writers exist while several hundred DMU Readers have been produced, deployed and are in current operational use. While DMU Writers suffer from poor reliability and severe parts obsolescence issues, they remain critical to successfully supporting routine AV-8B and F/A-18C/D flight operations. The DMU Writer is needed to generate AODs containing digital moving map data that are displayed in the cockpits of AV-8B and F/A-18C/D aircraft. Previously, when it was determined that a DMU Writer had either failed or was showing signs of becoming faulty, the unit would be returned to the Honeywell, Phoenix, AZ repair facility to undergo subsequent repair/rework action(s) via either a Naval Inventory Control Point (NAVICP) managed Repair-of-Repairables (RoR) contract or an NRL managed repair/rework contract. The Phoenix repair facility would then repair/rework the failed unit and ship it to the Honeywell facility in Albuquerque, NM so the repair/rework

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action(s) executed by Honeywell-Phoenix could be Validated/Verified (Val/Ver) on the DMU Writer test bench. If the Val/Ver of these repairs proved successful, the DMU Writer would be returned to the Phoenix, AZ facility for final check out and return shipment. If problem(s) were discovered during the repair Val/Ver checks, the unit would be returned to the Phoenix, AZ facility to undergo additional repair/rework action. Some failed DMU Writers proved especially difficult to repair, and this sometimes resulted in an iterative Repair/Rework-Val/Ver process occurring that could take several months to complete before the DMU Writer was successfully repaired.

1.3 Problem

Due to the failure of the DMU Writer test bench and the unavailability of needed repair piece parts, Honeywell-Albuquerque can no longer validate and verify the repair action(s) taken on failed DMU Writers without significantly redesigning the DMU Writer test bench hardware and software. Unfortunately, a DMU Writer test bench redesign would be cost prohibitive, and consequently this is not considered to be a viable alternative. Hence, an alternate DMU Writer Repair Process was devised to utilize the hardware and technical expertise resident at NRL, Stennis Space Center, MS. This hardware and expertise was gained by producing AODs in support of the USN F/A-18C/D and USMC AV-8B programs. NRL Stennis investigated the level of verification that could be accomplished with the current DMU Writer interface hardware and subsequently attempted to determine if this level of verification would be adequate to validate and verify the repair/rework actions implemented by Honeywell-Phoenix. Teleconferences conducted in November 2002 and January 2003 between NRL and Honeywell-Albuquerque representatives identified and established a set of DMU Writer test metrics that could be used to verify and validate a successful DMU Writer repair. Subsequently NRL Stennis and Honeywell-Albuquerque agreed the resultant test metrics could be used to develop an alternate DMU Writer test specification that would constitute a practical means of validating and verifying DMU Writer repair/rework action(s) executed by Honeywell-Albuquerque. Accordingly, this test specification is presented in section 3.0 of this document.

2.0 SCOPE

2.1 This specification defines the tasks and procedures necessary to verify and validate successful repair/rework action(s) using the Alternate Repair Process for the FIAF DMU Writer.

3.0 TASKS

3.1 Honeywell, Inc. (Phoenix, AZ Facility)

The Honeywell-Phoenix repair facility shall reset any and all error codes in the DMU Writer Non-Volatile Random Access Memory (NVRAM) prior to shipment to NRL Detachment, Stennis Space Center, MS.

3.2 Naval Research Laboratory (NRL) Detachment, Stennis Space Center, MS

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- 3.2.1 Prior to any other tests, NRL will inspect the contents of the NVRAM to insure that no errors have been set and stored. If any errors are detected during this inspection, the DMU Writer shall be labeled as **"failed"**, and will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.1.2 of this test specification. Otherwise, proceed to paragraph 3.2.2. **Note:** *All of the following tests will require use of one (1) blank AOD; hereinafter referred to as the, "Test AOD". Additionally, some of the following tests will require use of a second DMU Writer (previously determined and verified by NRL Stennis to be operating properly) as a secondary method of verifying Test AOD write test results. This secondary DMU Writer will hereinafter be referred to as the, "Bench DMU Writer".*
- 3.2.2 The first DMU Writer test shall be a "Recycle" test. A "Recycle" test finds the last available (unwritten) data sector of the Test AOD (this will be sector 97 for a blank AOD) and writes a new *Super-Directory* and *Characterization File* (requiring 6 data sectors total) within the first 96 data sectors of the Test AOD. Should any failure occur during the "Recycle" test process, the DMU Writer Under Test will be identified as **"failed"** and will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.2 of this test specification. Otherwise, continue to sub-paragraph 3.2.2.1.
- 3.2.2.1 Once the "Recycle" test has been successfully completed, the NVRAM contents of the DMU Writer Under Test shall be inspected. If any error(s) have been posted/stored in NVRAM, the DMU Writer Under Test shall be identified as **"failed"** and will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.2.1 of this test specification. Otherwise, proceed to sub-paragraph 3.2.2.2.
- 3.2.2.2 Additionally, should the "Recycle" test appear to execute normally, but the contents of the resultant Test AOD *Super-Directory* cannot be read (i.e. the "Recycle" test results cannot be successfully verified), the DMU Writer shall be identified as **"failed"** and will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed

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the test(s) identified in paragraph 3.2.2.2 of this test specification. Otherwise, proceed to paragraph 3.2.3.

- 3.2.3 Approximately 5 Megabytes (MB) of digital map data shall be recorded on the Test AOD using the DMU Writer Under Test. Should an **"Unrecoverable Write Error"** occur during the write process (see definition presented below), the DMU Writer Under Test shall be identified as **"failed"** and will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.3 of this test specification. (An **"Unrecoverable Write Error"** shall be interpreted as any error that prematurely terminates digital map data being recorded on the Test AOD, and also prevents the Super-Directory and Characterization File from being successfully recorded on the same AOD.) Should the 5 MB AOD Write test be successfully completed, proceed to sub-paragraph 3.2.3.1.

- 3.2.3.1 Once 5 MB of digital map data has been recorded on the Test AOD, the NVRAM contents of the DMU Writer Under Test shall be re-inspected for the presence of error(s). If any error(s) are posted in NVRAM, the DMU Writer Under Test shall be identified as **"failed"** and will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.3.1 of this test specification. Otherwise, proceed to sub-paragraph 3.2.3.2.

- 3.2.3.2 This test shall determine if the 5 MB of digital map data previously recorded on the Test AOD contains **"Unreadable Sectors"** (see definition presented below), and shall require use of both the DMU Writer Under Test and the Bench DMU Writer to quantitatively verify the presence of Unreadable Sectors. Initially the Test AOD will be loaded in the DMU Writer Under Test, and the DMU Writer Under Test will be used to check for the presence of Unreadable Sectors. Subsequently, the Test AOD will then be loaded in the Bench DMU Writer, and the Bench DMU Writer will be used to check for the presence of Unreadable Sectors. Should the Test AOD be found to possess one or more Unreadable Sectors using the DMU Writer Under Test and/or the Bench DMU Writer, then the DMU Writer Under Test shall be identified as **"failed"** and the DMU Writer Under Test will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.3.2 of this test specification. Otherwise, proceed to sub-paragraph 3.2.3.3. (An **"Unreadable Sector"** shall be defined as the posting of Data Response OpCode, **"FE"** combined with any or all of Transmission

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Status Bits "0", "1" and "2" being set to a value of "1", but Transmission Status Bits "6" and "7" remaining set at a value of "0".)

- 3.2.3.3 This test shall determine if the 5 MB of digital map data previously recorded on the Test AOD contains **"Uncorrectable Sectors"** (see definition presented below), and shall require use of both the DMU Writer Under Test and the Bench DMU Writer to quantitatively verify the presence of (25) or more Uncorrectable Sectors. Initially the Test AOD will be loaded in the DMU Writer Under Test, and the DMU Writer Under Test will be used to check for the presence of (25) or more Uncorrectable Sectors. Subsequently, the Test AOD will then be loaded in the Bench DMU Writer, and the Bench DMU Writer will be used to check for the presence of (25) or more Uncorrectable Sectors. Should the test AOD be found to possess (25) or more Uncorrectable Sectors using the DMU Writer Under Test and/or the Bench DMU Writer, then the DMU Writer Under Test shall be identified as **"failed"** and the DMU Writer Under Test will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.3.3 of this test specification. Otherwise, proceed to paragraph 3.2.4. (An **"Uncorrectable Sector"** shall be defined as the posting of Data Response OpCode, **"FE"** combined with any or all of Transmission Status Bits "0", "1" and "2" set to a value of "1" and Transmission Status Bits "6" or "7" also set to a value of "1".)
- 3.2.4 Write approximately 200 MB of digital map data to the Test AOD using the DMU Writer Under Test. (Note: The same Test AOD used for the 5 MB write test should be used for the 200 MB write test. Any subsequent 200 MB write test being executed in accordance with sub-paragraph 3.2.4.4 of this test specification must utilize a second Test AOD.). Should an **"Unrecoverable Write Error"** occur during the 200 MB write test (as defined in paragraph 3.2.3), then the DMU Writer Under Test shall be identified as **"failed"** and it will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.4 of this test specification. Otherwise, proceed to sub-paragraph 3.2.4.1.
- 3.2.4.1 Upon successful completion of the 200 MB write test, the NVRAM contents of the DMU Writer Under Test shall be re-inspected. If any error(s) are posted in NVRAM, the DMU Writer Under Test shall be identified as **"failed"** and will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s)

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identified in paragraph 3.2.4.1 of this test specification. Otherwise, proceed to sub-paragraph 3.2.4.2.

3.2.4.2 This test shall determine if the 5 MB and/or 200 MB of digital map data previously recorded on the Test AOD contain "**Unreadable Sectors**" (as defined in sub-paragraph 3.2.3.2), and shall require use of both the DMU Writer Under Test and the Bench DMU Writer to quantitatively verify the presence of Unreadable Sectors. Initially the Test AOD will be loaded in the DMU Writer Under Test, and the DMU Writer Under Test will be used to check for the presence of Unreadable Sectors. Subsequently, the Test AOD will then be loaded in the Bench DMU Writer, and the Bench DMU Writer will be used to check for the presence of Unreadable Sectors. Should the Test AOD be found to possess one or more Unreadable Sectors using the DMU Writer Under Test and/or the Bench DMU Writer, then the DMU Writer Under Test shall be identified as "**failed**" and it shall be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.4.2 of this test specification. Otherwise, proceed to sub-paragraph 3.2.4.3.

3.2.4.3 This test shall determine if the 5 MB and/or 200 MB of digital map data previously recorded on the Test AOD contains "**Uncorrectable Sectors**" (as defined in sub-paragraph 3.2.3.3), and shall require use of both the DMU Writer Under Test and the Bench DMU Writer to quantitatively verify the presence of (25) or more Uncorrectable Sectors. Initially the Test AOD will be loaded in the DMU Writer Under Test, and the DMU Writer Under Test will be used to check for the presence of (25) or more Uncorrectable Sectors. Subsequently, the Test AOD will then be loaded in the Bench DMU Writer, and the Bench DMU Writer will be used to check for the presence of (25) or more Uncorrectable Sectors. Should the Test AOD be found to possess (25) or more Uncorrectable Sectors using the DMU Writer Under Test and/or the Bench DMU Writer, then the DMU Writer Under Test shall be identified as "**failed**" and it shall be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.4.3 of this test specification. Otherwise, proceed to sub-paragraph 3.2.4.4.

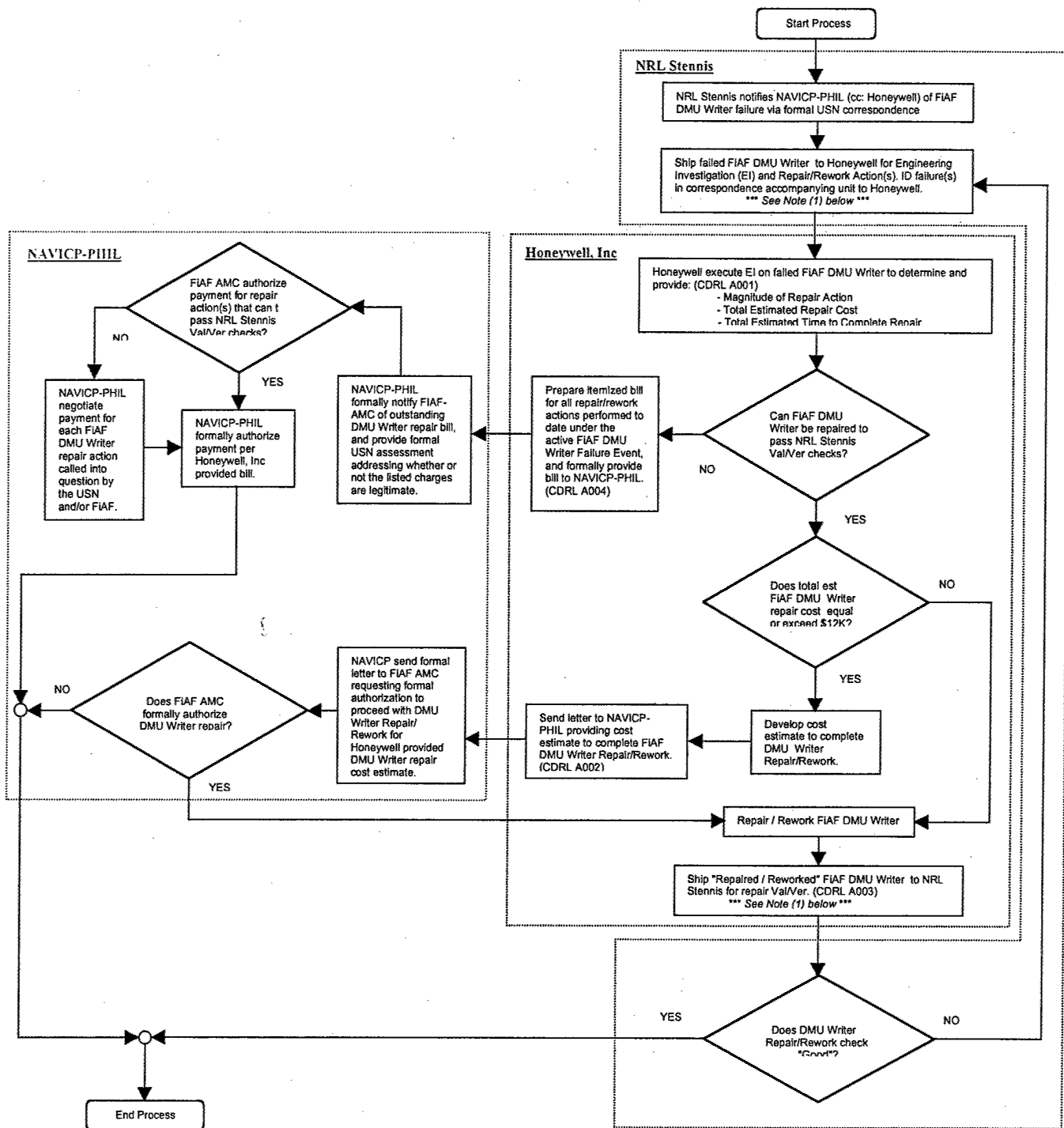
3.2.4.4 This test shall determine if the 5 MB and/or 200 MB of digital map data previously recorded on the Test AOD contains "**Recoverable Write Errors**" (see definition presented below), and shall require use of both the DMU Writer Under Test and the Bench DMU Writer to quantitatively verify the presence of more than (100) Recoverable Write Errors. Initially the Test AOD will be loaded in the DMU Writer

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Under Test, and the DMU Writer Under Test will be used to check for the presence of (100) or more Recoverable Write Errors. Subsequently, the Test AOD will then be loaded in the Bench DMU Writer, and the Bench DMU Writer will be used to check for the presence of (100) or more Recoverable Write Errors. Should the Test AOD be found to possess (100) or more Recoverable Write Errors using the DMU Writer Under Test and/or the Bench DMU Writer, then each of the tests identified under paragraph 3.2.4 of this test specification must be repeated using a second Test AOD. If the second Test AOD containing the 200 MB of digital map test data fails any of the tests identified under paragraph 3.2.4, then the DMU Writer Under Test shall be identified as **"failed"**, and it will be returned to Honeywell-Phoenix for further repair/rework action in accordance with the process depicted in attachment (1) of this test specification. The NRL Stennis correspondence accompanying the return of the failed DMU Writer to Honeywell shall identify/note the enclosed asset failed the test(s) identified in paragraph 3.2.4.4 of this test specification. Otherwise, proceed to paragraph 3.2.5. (A **"Recoverable Write Error"** shall be defined as an error that is not a critical error, but whose presence in significant numbers (i.e. greater than 100) generally indicates a mechanical failure/problem is present within the DMU Writer Under Test. Recoverable Write Errors typically result from slight mechanical misalignments in the optics drive assembly, poor/weak laser power, and defects in the AOD glass media.) Note: If it is observed that write error(s) occur only when using the Bench DMU Writer during the verification process, an Alternate Bench DMU Writer shall be used to confirm the write test results obtained from executing the tests identified under paragraph 3.2.4. In this case, the write test verification results obtained from using an Alternate Bench DMU Writer shall take precedence.

- 3.2.5 If the Test AOD generated by the DMU Writer Under Test passes all the tests identified in paragraphs 3.2.2, 3.2.3 and 3.2.4 of this test specification, all the tests identified under paragraphs 3.2.2, 3.2.3, and 3.2.4 of this test specification shall be repeated using the blank side of Test AOD. If the digital map data recorded on the second side of the Test AOD successfully passes all the identified tests under section 3.0 of this test specification, then the repair/rework action(s) executed by Honeywell on the DMU Writer Under Test shall be verified/confirmed as "Successful" by NRL Stennis, MS, and the Naval Inventory Control Point, Philadelphia, PA shall be formally notified in writing of this fact in accordance with the process depicted in attachment (1) of this test specification.

FiAF/USN Alternate DMU Repair Process



Note(s):
 (1) Use TAC Code P355 against FMS Case FI-P-MAD to pay for DMU shipping/transfer costs. Notify the Finland F-18 Program Transportation Manager (Ms. Diana Altott) of an impending DMU Writer shipment by calling her at (703) 944-5652 and/or e-mailing her at, "altodi@ispec.com".